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Put $a=7$ miles, $b=5$ miles, and $c=4\frac{1}{2}$ miles. Also put $2d=\frac{1}{5}$ hour, difference in time in making the journeys.

Then, $\frac{a}{b+x}+\frac{y}{b-x}=T\ldots.(1)$; $\frac{a-y}{c-x}=T\ldots.(2)$; $\frac{a-z}{b-x}=t\ldots.(3)$;

$\frac{z}{c-x}+\frac{a}{c+x}=t\ldots.(4)$; and $T=d+t\ldots.(5)$.

From (2), $y=Tx-Tc+a\ldots.(6)$. From (3), $z=tx-tb+a\ldots.(7)$.

Substituteing value of y in (1), $\frac{a}{b+x}+\frac{Tx-Tc+a}{b-x}=T\ldots.(8)$.

From (5) and (6), $\frac{a}{b+x}+\frac{dx+tx-cd-ct+a}{b-x}=d+t\ldots.(9)$.

Whence, $t=\frac{b^2d-2dx^2-2ab-bdx+bcd+cdx}{2x^2-b^2+bx-bc-cx}$.

The value of z in (4), gives, $\frac{tx-tb+a}{c-x}+\frac{a}{c+x}=t\ldots.(10)$,

whence $t=\frac{2ac}{c^2-2x^2-cx+bx+bc}$. Equating these two values of t, after restoring numerical values, we have $\frac{252}{171-8^2+2x}=\frac{4x^2+x+1305}{950-10x-40x^2}$, from which $32x^4-326x^2-5301x=-16245\ldots.(11)$.

Factoring (11), $(x^2-7\frac{3}{4}x+14\frac{1}{4})(32x^2+248x+1140)=0$.

From first factor, $x=3$ or $4\frac{3}{4}$, and from 2nd $x=-8.25062$ or -7.24938. But of these values only $x=3$ is applicable. By substituting, $2T=5$ hours, $2t=4.8$, $y=3\frac{1}{4}$ miles, and $z=2\frac{1}{5}$ miles.

Also solved by *F. P. MATZ and G. B. M. ZERR.*

28. Proposed by H. W. DRAUGHON, Clinton, Louisiana.

The working capacity of a horse is constant between the ages of a and b years, and decreases at a uniformly accelerated rate from the age of b years to that of c years, becoming 0 at the latter age. If the value of the horse at the age of a years is d, give a formula for finding his value at any subsequent time.

Solution by the PROPOSER.

Let m represent the value of a year's work between the ages of a and b years; then, the value of the total amount of work done between those ages is, $(b-a)m\ldots.(1)$.

Let y be the value of the work which the horse could do in one year at the age of $c-1$ years, and let x be any variable time reckoned from the age of c years backward. Then from formulas for uniform acceleration, we have,

$m=(c-b)^2y$. $\therefore$ $y=\dfrac{m}{(c-b)^2}$. The value of the work which could be done at the age of $c-x$ years is, $x^2y=\dfrac{mx^2}{(c-b)^2}$.

$\therefore$ the value of total amount of work done between the ages of b and c years is, $\dfrac{m}{(c-b)^2}\displaystyle\int_0^{c-b}x^2dx=\tfrac{1}{3}m(c-b)$.

Adding this to value given in (1), we have, $\tfrac{1}{3}m(c-b)+m(b-a)=d$, since d=value of horse's work from a to c years of age.

$\therefore$ $m=\dfrac{3d}{c-3a+2b}$. For any age, $b-n$, between the ages of a and b years, we have, the value of horse, V=value of work done after that age $=mn+\tfrac{1}{3}m(c-b)=\dfrac{3d}{c-3a+2b}[n+\tfrac{1}{3}(c-b)]\dots.(A)$.

For any age, $c-n'$, between the ages of b and c years, we have, value of horse,

$$V'=\frac{m}{(c-b)^2}\int_0^{n'}x^2dx=\frac{mn'^3}{3(c-b)^2}=\frac{dn'^3}{(c-b)^2(c-3a+2d)}\dots.(B).$$

Ex. Let us suppose that a horse is worth \$100 at five years of age, and that he begins to weaken at 18 years of age, becoming worthless at 20. Then, $a=5$, $b=18$, $c=20$, and $d=100$. Substituting (A) becomes,

$V=\dfrac{100(3n+2)}{41}$, (A), and (B), becomes, $V'=\dfrac{25n'^3}{41}\dots.(B)$. By substituting for n and n' their successive integral values, we construct the following table:

years	value	years	value	years	value
5	\$100	10	\$63.41	15	\$26.82
6	92.68	11	56.09	16	19 51
7	85.36	12	48.78	17	12.19
8	78.04	13	41.46	18	4.87
9	70.73	14	34.14	19	60
				20	00

Also solved by *F. P. MATZ. and G. B. M. ZERR.*

29. Sugested by MANSFIELD MERRIMAN, C. E., Ph. D., Professor of Civil Engineering, Lehigh University, South Bethelehem, Pennsylvania.

Solve neatly the equations: $\dfrac{y(1+x^2)}{x(1+y^2)}=a\dots.(1)$, and $\dfrac{y^4(1+x^8)}{x^4(1+y^8)}=b\dots.(2)$.

I. Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

Write (1) and (2), respectively,

$$x+\frac{1}{x}=a\left(y+\frac{1}{y}\right)\dots.(3),\text{ and }x^4+\frac{1}{x^4}=b\left(y^4+\frac{1}{y^4}\right)\dots.(4).$$